Issue 51
August 2023

Utah Valley Amateur Radio Club

The UVARC Shack

Move over, guys

Happily, more female participants operated our station radios this year than perhaps during any previous Field Day. All four stations, which included the three main (3A) RVs and the GOTA station, had a lot of women and youth lined up to operate. In this photo, Kinzie and Brielle, respectively, granddaughters of Doug Bosen W7GPD, operate and log while Aspen Douglas KK7ENH and her mother Valerie Douglas KK7DWI await their turn.

In this issue of the *UVARC Shack*

Club meetings feature a Field Day duet, plus our Ham Radio Fair.

Silent Key for KJ7SNL, W7DKR, and K7QDQ. *My Shack* spotlights KE7SAO. *Amateurs in Action* in Payson Canyon. *Brass Tacks* on impedance.

Dear Annette on whether EchoLink is "real" ham radio. *Hot Tips* for vehicle preparedness. *DIY* for a 40/80 cobra antenna. *The Amateur in You* on electrical components and what part social media can play in an emergency.

Please send your ideas, stories, questions, gripes, and photos to ***uvarcshack@gmail.com***

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Club meetings

Recap

June 2023 club meeting – Husband and wife Field Day team

Ahead of Field Day, we received a real treat from one of our favorite ham radio couples, Jessica Johnson KJ7UVZ and Ryan Johnson KG7RJ. Thanks to Curtis MacPherson N1JDI and volunteers, for adding to an already fun presentation. After this demo, we're pumped and ready to take on the nation in the last Saturday of June at Trout Creek, near Strawberry Reservoir. You can see a recording of the meeting on this link, thanks to Trevor Holyoak AG7GX.

July 2023 club "meeting" – Ham Radio Fair

We had a terrific turnout at the Ham Radio Fair on Thursday July 13 at Pheasant Brook Park in Lindon. The club holds the fair in replacement of the regular monthly meeting, due to the proximity of Field Day, and to offer those who couldn't attend regular Field Day a way to gather and get on the air. We've included a few photos on page 14.

By the way, many of our past meetings are recorded and posted on the club YouTube channel.

Silent Key

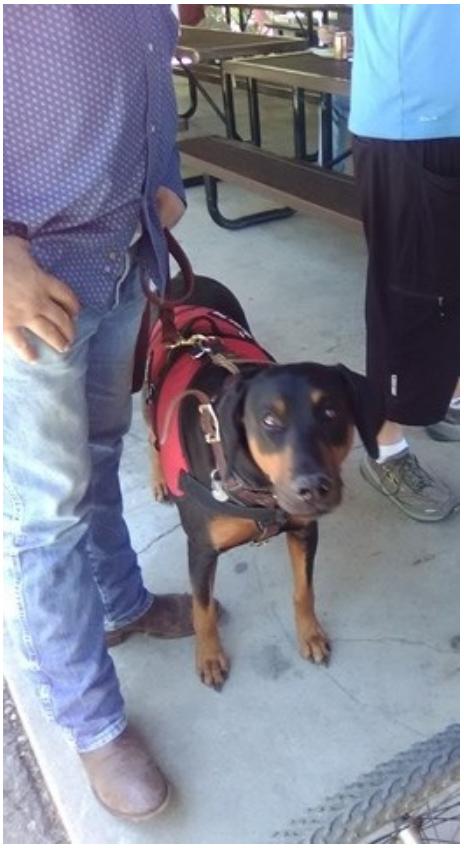
Memorial for a ham who has passed on

Roy Deeben, KJ7SNL

True to his call sign, Roy "Saturday Night Live" Deeben KJ7SNL passed away on Saturday night 17 June 2023, with his lifelong friend and companion Zeus, his service dog, nearby. Roy was a gentle and sensitive friend to many on the air, always ready to help out with a project or mentoring when his health permitted. He was a living example of "the spirit is willing, but the flesh is weak."

According to Roy's obituary, he joined the Army in 1985, and served various occupations over ten years, then afterwards became quite the gun and reloading expert as a result. He was fond of hunting, camping, shooting, reloading, photography, wild mustangs, and of course, ham radio.

Close friends, including Jon Babb KJØNAB, encouraged Roy to get licensed. He kept his original call sign he received when he first got licensed in October 2020, so it's not a vanity call, and Roy became a UVARC member soon after. Since then, numerous hams have known him as the helpful guy in Payson with the big voice on the '76 repeater or the New Ham Net. Roy has volunteered to help out with a number of events, including Winter Field Day, the Ham Radio Fair, and a local park special event station, plus attended the 76ers Barbecue, the Lunch Bunch, and many club meetings.



His funeral was held at Camp Williams, Utah, with military honors, followed by a Final 7-3.

73, old friend.

Silent Key

Memorial for a ham who has passed on

Dave Raab, W7DKR

On Wednesday 21 June 2023, club member and friend Dave Raab W7DKR passed away at Utah Valley Hospital, with his wife Emma KJ7BEN and son Mike next to him.

Here's a summarized excerpt from Dave's obituary:

At the age of 12 Dave fell in love with ham radio, which was a passion he had nearly his entire life. He went to high school in Escondido, California, where he became the president of the school ham radio club.

In 1950, Dave enlisted in the US Navy Reserve and after being discharged, he worked for the US Forest Service. In 1968, Dave moved to Utah and continued working for the Forest Service. He had a love of the outdoors and enjoyed camping, fishing, and hiking for many years. He also loved BYU Football and had season tickets for most of the 1980s. After Dave's wife passed away, he kept busy by serving a Family History mission for the Church of Jesus Christ of Latter-day Saints. It was then he met and married Emma.

Dave was proud to be a part of the Utah Honor Flight #37 in September 2021 and had deep pride in being a veteran. Military honors were performed by American Legion Post 72, the Patriot Guard Riders, and the Utah Pipe Band, at the Orem City Cemetery.

As much as age and health permitted, Dave attended club meetings and came to a number of our lunches. He often checked into the UVARC HF Net on Wednesday nights, and has made numerous contacts worldwide. Just recently, the ARRL awarded Dave with a 70-year certificate, celebrating his long-standing membership in the organization, one of the few ever to achieve the recognition. We had planned to present the award to Dave in our August meeting, but apparently it wasn't meant to be.

73 and rest in peace, young man.

Silent Key

Memorial for a ham who has passed on

Larry Giovannoni, K7QDQ

On Monday 10 July 2023, our dear friend, grandpa, 76er, and dad to Jeremy K7TEH, Larry Giovannoni K7QDQ passed away at home early in the morning, with his wife Diane by his side.

Larry checked in occasionally to the 76ers Net, and was a regular on the Monday night Jackson Hole Net. He and Mick would sometimes rib each other, especially when Larry had to answer Mick about all the fish he didn't catch.

A few portions of his life sketch from Larry's obituary:

He served the US Army in Panama during the Noriega conflict in the 1980s, then the 115th Engineer Battalion of the Utah National Guard, and later as crew chief working on Apache and Black Hawk helicopters at West Jordan Airport Number 2 in the 211th Aviation Regiment. He later served with American Fork Ambulance, then as a firefighter in the Alpine / Highland Fire Department (now the Lone Peak Fire District.)

Larry loved his wife, kids and grandchildren so much that he would have done nearly anything for them.

He got his start in ham radio as he and wife Diane wanted a way to remain in contact with each other, in case of a need to communicate. They originally relied on CB radio, but eventually realized they needed something better. So, when they heard that the 146.760 repeater had a phone patch, that seemed to be the answer, and the two of them became licensed amateurs in 1982, Larry as KA7QDQ and Diane as KA7QDR. In 2012, Larry upgraded to General, then changed his call sign to K7QDQ the following year.

A couple of years ago, the temperature plummeted, and it actually snowed, during UVARC's Field Day for the first time that any of us could remember. Larry took grandson Ethan, and the two headed up the mountain, collected a ton of firewood, and brought it all back to camp. He started a fire that kept the potluck partygoers toasty.

The very next morning, Larry and Ethan went down to the (Strawberry) reservoir and caught two large pots full of crawdads, brought them back to the site, and made a huge "lobster boil" right there at camp for the campers to share. The two were an inseparable team of service to their neighbors. Without being asked, Larry often took the initiative to care for others, even at great inconvenience to himself. For that alone, he'll be greatly missed.

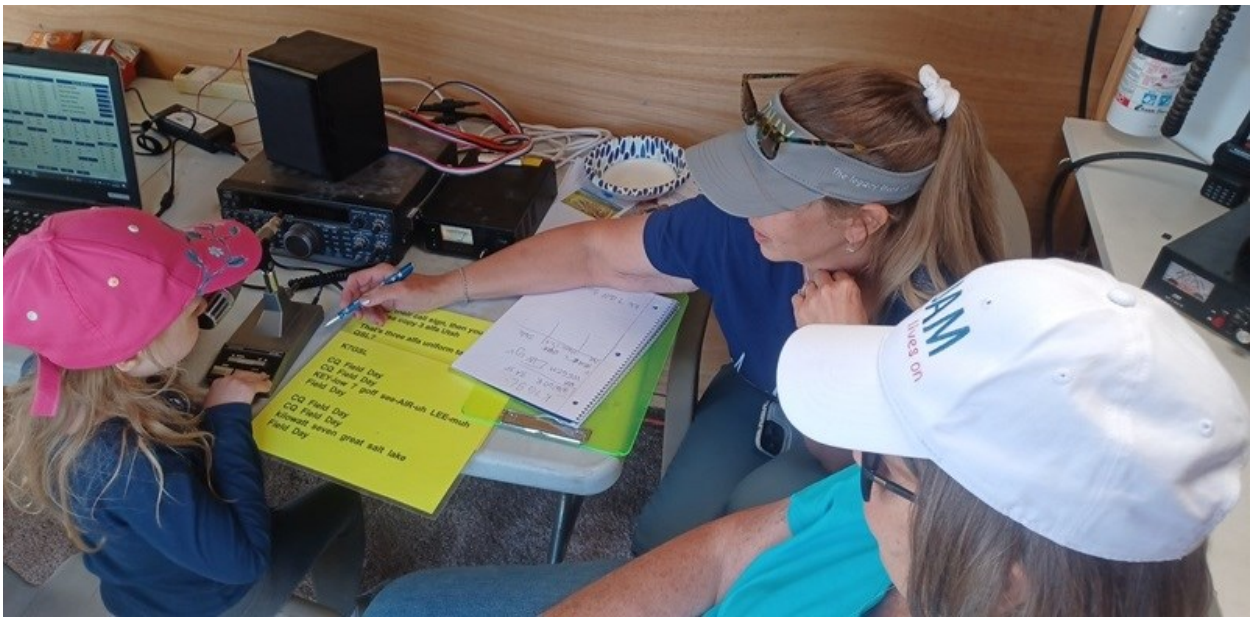
73, Larry, and rest in peace old friend.

Field Day

In photos

Field Day

Continued



Field Day

Continued

My Shack

Highlighting the shack (ham equipment and room) of a member, to give others an idea of the possibilities that might work for them

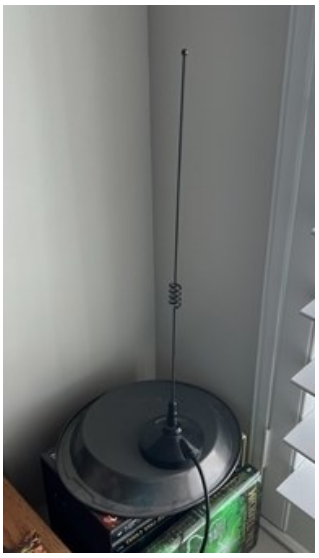
Brent Gray KE7SAO

My Grandpa Romeo (KE7SAO) got me interested in amateur radio. He spent his whole life around radios, starting with the military. One time my grandfather became ill, and when I visited him in the hospital, he was reading the latest issue of the ARRL magazine QST. *After I sat down next to his bed, he unexpectedly handed me all the many* QST *magazines that he had with him, and said that this is something I would be interested in. I remember asking him what made him think I would enjoy this. He smiled and just said, "trust me, you'll fall in love with it."*

Well, fall in love with it I did! After telling my grandpa I read all of the magazines he gave me (not completely true) he handed me a Technician study guide and asked whether I was still interested; I told him I was all in and started studying. On April 2016 I passed the Technician exam and was given the call sign KI7GYY.

My grandpa and I got on the radio together many times, and he even took me to his local radio club in Arizona, the Sunlife Amateur Radio Club. After two years as a Technician, he said I was ready to move up, so I studied for my General, which I received in July 2018.

When my grandfather passed away 2 months later, I decided right then that I wanted people in the amateur radio community to know it was because of him that I became a ham. So I studied my heart out for two straight weeks, and once again passed the exam, and earned the Amateur Extra license in October of 2018. Following that wonderful experience, I applied for and received a vanity call sign; not just any vanity call sign, my grandfather's call sign, KE7SAO. So, now whenever you hear my call sign on the radio, you'll know that it was my grandpa that got me to where I am, and that I'm an OHHH so awesome person!



My equipment includes a TYT TH-9800 VHF/UHF mobile rig connected to a Tram 1185 mobile antenna mounted on a pizza tin, and three Baofeng UV-5R HTs with Nagoya NA-771 whip antennas.

I'm now trying to complete my levels of certification in UCARES. My goal is to train people in emergency preparedness and to help the younger generation know and understand the value that ham radio communication still has in our very high-tech society.

Brent is the door prize master at our club meetings, often checks in to the 76ers Net, and is the self-proclaimed "Youngest Member of the 55-plus Community" where he lives.

73, Brent Gray KE7SAO

Amateurs in Action

Recounts of ham radio operators who have used their effort and skills to help others in a time of need

Payson Canyon Rescue

Dave Becar KI6OSS

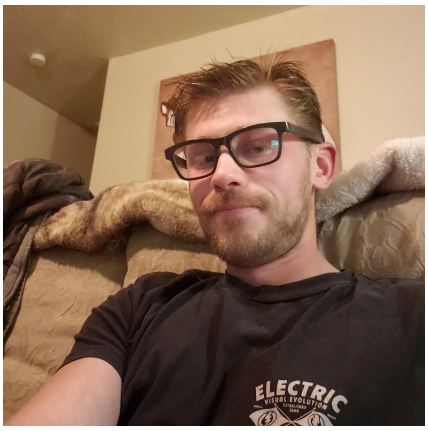
Saturday 03 June 2023, Dave Becar KI6OSS was just wrapping up his communication tasks in the *Eagle Mountain Pony Express Days* parade.

I drove home about 12:30 pm and went down to my shack to write up a small report of our event and the support team. While preparing my report, I turned on my dual-band mobile radio just monitoring a local repeater. Around 1 pm, I heard James KK7AVS asking for a signal check. I responded to his call and gave him a favorable report.

James proceeded to tell Dave that he was in his pickup truck way up Payson Canyon, and needed some help. At his location, there was no cell phone coverage, and his only means of communication was through his radio. James explained that he had driven as far as he could, but had reached a locked gate at the top of the canyon. He managed to turn his truck around and was going to head back down, but his truck stalled and would not restart. James explained that his truck was all electronic, and so was unable to start it or shift into any gear to even coast down the canyon.

As we talked, James asked me to call his friend and share his situation, which I attempted, but got no response. He asked if I could call CJ, another friend. CJ answered, and I explained what was going on. During this time a dangerous storm alert came over the radio emergency channel for some nearby counties, one of which was within James' vicinity. Having contacted CJ on his phone and using ham radio, we were able get James' exact location in between two campgrounds on the Mount Nebo Loop.

It took about three hours, but once Dave made the phone calls and relayed the necessary information between James and his friends, the tow truck was able to locate James and his stranded vehicle, and tow him to safety.



James Bennett KK7AVS

There were a few tense moments when we had concerns for his safety, but everything worked out, and we were grateful for the use of amateur radio, which made the entire rescue possible. All it required was listening, making a few phone calls, and using radio for emergency communication.

James was on a "mission" as secretary for his club (Utah Amateur Radio Club) to scout out a Field Day location. *He later sent me an email thanking me for my small part in helping him, and has encouraged me to share this story with others.*

Dave serves as the organizer for the Eagle Mountain Emergency Communication Team and served that day as Net Control for the Eagle Mountain Pony Express Days parade.

76ers Barbecue

In photos

76ers Barbecue

Continued

New Hams and Upgrades

New hams

KK7NCX = Shad Daniels
KK7NCZ = Sharman Gill
KK7NDC = Calvin McCoy
KK7NDS = Laith Mohammad
KK7NDT = Nikolas Okhrimenko
KK7NDU = Joshua Overson
KK7NFA = Nathan Ashby
KK7NFL = Porter Clark
KK7NKZ = Dakota Mundell
KK7NNN = Ren D'Angelo
KK7NQO = Trevor Bruford
KK7NSJ = Patrick Maloy

Upgraded hams

K7FBI = Steven Clark (General)
KD6STC = Cary McGagin (General)
KK7DRV = Kenneth Abel (General)
KL7KUY = Matthew Barnes (General)
KM6SWV = Daniel Landon (General)
N7GPB = Geoffrey Brown (General)
KJ7ZZB = James Littlefield (General)
KK7FOR = Micah Eastwood (General)

Congratulations to all these diligent folks! We look forward to hearing you on the radio soon.

Ham Radio Fair

In photos

Events

Upcoming happenings

UVARC 2023 Swap Meet

Heads up! The Utah Valley Swap Meet this year will be 9:00 am Saturday September 30, at the Spanish Fork North Park Pavilion, 1185 N 400 E. One of our few fund-raisers ever, entrance is $5 per person or $10 per family, plus $10 per table to display your wares. The *fee is waived* for outside clubs and service (ARES, RACES, CERT, etc.) groups who want to get the word out.

More than just a flea market, we hold this swap meet annually to provide

- Information on how to get active with many aspects of ham radio, such as HF, digital, APRS, POTA, SOTA, portable, solar, and much more
- A chance for service organizations to invite and inform attendees and recruit members
- Radio programmers who could program your radio on the spot

Bring stuff you want to get rid of or show off, or come and browse the many things that are for sale, in case you find something you need, or both. You'll find many give-away items as well.

Dave Becar KI6OSS plans hold an exam session at the swap meet just outside the pavilion, under the Laurel VEC. Watch for updates on FB and emails, as time progresses. This is a family event, and we'd love to see yours at the Swap Meet!

76ers Annual Ice Cream Social

It's time once again for the 76ers Annual Ice Cream Social, at Leatherby's in Orem, 304 E University Pkwy. Bring your family on Saturday September 9 at 1:00 pm and join us for lunch and treats. They have burgers, fries, and deli sandwiches, as well as world-class shakes, ice cream cones, sundaes, and parfaits.

Elections

The Utah Valley Amateur Radio Club will be holding our annual elections during the monthly club meeting on Thursday September 7 at 6:30 pm. Club members will be voting (in-person only) for the president, vice president, secretary, activities chair, and the technology specialist. If you'd like to throw your hat into the ring and run against any current posts, please let one of the leadership know, and they'll get your name on the election ticket.

DIY Night

Our November 2023 club meeting will be our annual DIY (do-it-yourself) night, where you can learn (or help teach!) a skill or concept to club members. This one will be held at the Orem Senior Friendship Center, 93 N 400 E starting 6:30 pm. Come learn about soldering, installing a connector, using Anderson Powerpoles, how to apply heat shrink, how to program a radio, how to set up your own mini-repeater, how to analyze an antenna, and more. Info as we get closer.

If you'd like to showcase a concept, please let one of the club leadership know. We'll give you a half-table to set up your demo and poster board or literature!

Brass Tacks

An in-depth look at a radio-related topic

Impedance

When we venture into building amateur radio gear, such as an antenna, balun, or even a tuner, we'll likely encounter the notion of *impedance*. Even if we're not into making stuff, we might still run into this word, since it seems to be coupled with how we connect our equipment. But *just what is it*, and more importantly, *why do we need to know about it?* In a separate article, we touched briefly on impedance as an effect inherent to passive components, but this discussion focuses on the property itself.

In the amateur radio world, electrical impedance is the property of opposition to (reduction of) electrical current flow, expressed in *ohms*, symbol Ω. It's represented by the mathematical expression

$$Z = R + jX$$

in which **Z** represents impedance, **R** is resistance, **j** is the imaginary unit (square root of −1), and **X** represents reactance.

Resistance is simply the opposition to current flow, without regard to frequency, and it's fairly easy to grasp because it's part of the familiar Ohm's Law

$$E = I \times R \text{ or } I = E \div R$$

In other words, the current through a resistive component is related to the electrical pressure (voltage) placed on it, and the component's ability to resist the pressure.

As you can see from the expression, impedance is a complex number, meaning that it has a *real* portion and an *imaginary* portion, and that imaginary part is what tends to make understanding it a little challenging. Especially when you consider that reactance, the imaginary part, is further defined by whether it arises from inductance or capacitance, and is defined as

$$X = X_L - X_C$$

in which the two reactance quantities are defined as

$$X_L = 2\pi fL \text{ and } X_C = 1/(2\pi fC)$$

in which **f** is the frequency, **L** is the inductance, and **C** is the capacitance. This makes the total impedance equation

$$Z = R + j[2\pi fL - 1/(2\pi fC)]$$

Brass Tacks

continued

meaning that impedance can be frequency-dependent. Also, because impedance is a complex number, there exists another complex number that acts as its counterpart, known as its *complex conjugate*, such that, if **Z = R + jX**, its complex conjugate (denoted ***Z****) is

$$Z^* = R - jX$$

and the only difference being that the reactances are opposite in sign. As will be explained later, this complex conjugate can prove useful in some applications.

Impeded flow

Electrical impedance is not related to the speed of anything, so electron speed or even energy speed does not affect impedance, and vice versa. The speed of electricity (electrical energy) depends solely on the material ("medium") through which it travels. So, exactly what is being impeded? It's the volume of electrical charge (number of electrons) that passes through a particular point per second, also known as the flow of electrical current, not how fast they're moving. Speed is measured in length per second, but flow is measured in volume per second.

To better visualize this, let's slow things down to a snail's pace. Say we have a box full of snails, and we want them all to go through a medium-sized hole in our fence to the field out in back, so that they can only go through about three or four at a time. No matter how big or small the hole is, the snails all travel at the same speed (except the one with the rocket), yet the size of the hole restricts the number of them that can get through at any given moment.

When I apply pressure (voltage) on the snails by tempting them with beer (they love the smell of the cooked yeast) in the field, they begin their march through the hole. And the number of them going through at any time (current) is again limited by the size of the hole (impedance). Not a perfect analogy, but I believe you get the idea. Even if I attempt to pressure the snails to go through in greater quantities, they still move at the same speed – a snail's pace.

Resonance

It's difficult to mention impedance without mentioning resonance, since resonance depends on impedance. In fact, passive electrical resonance is no more than a state in which a network of reactive components (inductors and capacitors) exhibits an impedance consisting only of the resistance of the wires; that is, with the reactances completely canceled, and the resistance very small. Because this phenomenon occurs at a unique *resonant frequency*, it's useful in amateur radio for use as a *tuned circuit*, to allow you the reception of signals from a particular band (range) of frequencies, while filtering out all others.

To demonstrate how this might be useful, let's design a *trap antenna*; that is, an antenna de-

Brass Tacks

continued

signed for one band, but uses a device called a *trap* to allow it to act like an antenna on another band. For convenience (and simplicity), let's design the trap for a 40-meter dipole, so that it's also resonant on 20 meters. To achieve that, let's assume the trap inhibits all signals except those for 40 meters, This means the trap acts like a wire (0-ohm short circuit) at 40 meters, say, 7.2 MHz. Performing the math for impedance, then, yields

$$Z = R + jX = 0 \text{ ohms}$$

Since the wire is short enough (about 65 feet) to assume that its resistance R is also 0 ohms,

$$0 = 0 + jX \text{ ohms}$$

therefore, **X** = **0**, but

$$X = X_L - X_C = 2\pi fL - 1/(2\pi fC) = 0$$

$$2\pi fL = 1/(2\pi fC)$$

Then, solving for **C**, we have

$$C = 1/(4\pi^2 f^2 L)$$

If we create an inductor out of a length of coiled wire, and measured it on an analyzer, let's say it displays around 40.7 µH of inductance. The capacitor value is then

$$C = 1/[4\pi^2(7.2 \text{ MHz})^2(40.7 \text{ µH})] = 12 \text{ pF}$$

Therefore, cut the 65-foot wire in half and place a 12 pF capacitor in series with your 40.7 µH coil, and you've got yourself a 20-meter / 40-meter trap antenna. It'll be close to the correct length for a 20-meter dipole antenna, and then perform perfectly on 40 meters when you attempt to transmit on 40 meters because of the "short circuit" you've created at that frequency.

Characteristic impedance

All electrically conductive things possess impedance, and more often than not, their impedances are defined by the types and geometries (sizes and shapes) of the materials they're made of. But their impedances also vary with frequency, making many conductors unsuitable as transmission lines, which are wires or other conductors that carry RF (radio frequency) electrical signals between the transceiver and the antenna.

We can design a transmission line such that its impedance remains fairly constant for a large workable frequency range and length, and we call this constant impedance the *characteristic impedance*. Amateur radio feed lines, such as coax (coaxial cable), window line, and ladder line are constructed in such a way, and each exhibits a characteristic impedance that's fairly constant over a large, workable frequency range.

By definition, characteristic impedance is that of the input for an infinitely long transmission line. Another way to look at it is the value of resistance that, when used as a termination

Brass Tacks

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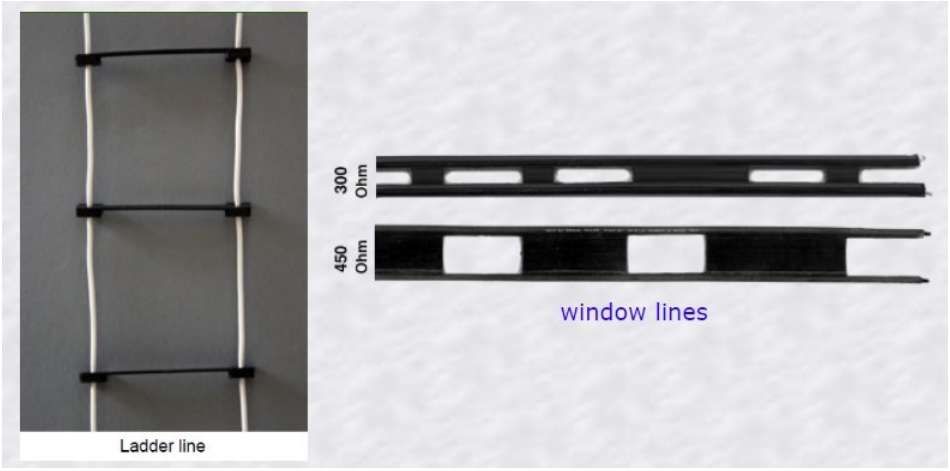
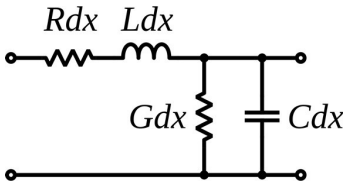


(called the load) at the output of the line, makes the input impedance of the line independent of the electrical length of the line. The typical characteristic impedances of the examples I gave are 50 ohms for coax, 300 ohms for mini-window line, 450 ohms for regular window line, and 600 ohms for open ladder line, also called open wire line.

But just how is the impedance of coax 50 ohms? The following diagram generalizes the appearance of almost any transmission line, such as coax, in which ***Ldx*** is the inductance per unit length and ***Cdx*** is the capacitance per unit length:



The cable does indeed exhibit some resistance, labeled ***Rdx***, but that value tends to be rather small, typically less than a third of an ohm for 100 feet of RG-8X and less than a tenth of an ohm for 100 feet of LMR-400, for example. The conductance, labeled ***Gdx***, is the reciprocal of the huge resistance (as will be described later, under **Admittance**) between the center conductor and shield, so tends to be very small, in the order of micro-siemens per foot. The generalized equation for transmission line impedance is defined as shown on the left:

$$Z = \sqrt{\frac{R + sL}{G + sC}} \qquad Z_0 = \sqrt{\frac{sL}{sC}} = \sqrt{\frac{L}{C}}$$

In this case, ***s*** is the imaginary unit and frequency, or j2πf. If ***R*** and ***G*** are as small (effectively zero) as we believe, then the frequencies (the two ***s*** variables) cancel, and we have Z_0, the characteristic impedance as shown on the right. For example, given that RG-8X cable exhibits 0.077 µH/ft and 30.8 pF/ft, the Z_0 for RG-8X = √[(0.077 µH/ft)/(30.8 pF/ft)] = 50 ohms.

Brass Tacks

continued

But if the frequency values cancel (because the cable resistance and conductance values are so low), it means this characteristic impedance holds, regardless of frequency. In real-life, however, an actual cable does have an upper usable frequency limit. RG-8X can by used to 1.0 GHz and LMR-400 can be used to 6.0 GHz, for example, depending on the manufacturer.

Maximum power transfer

Let's connect a transceiver to a transmission line (coax) input and "look" into the output of the line back toward the transceiver at the antenna end. The impedance we should "see" at the output end is the **lumped sum** of that of the transceiver and that of the transmission line, and let's call it $\boldsymbol{Z_S}$, the two impedances combined as the *source impedance*. Let's then place our load impedance ($\boldsymbol{Z_L}$, which might be an antenna) on the antenna end, the output of the line.

We now have essentially a circuit with the source voltage, the source impedance, and the load impedance. The question of interest here is, What value of $\boldsymbol{Z_L}$ can give us the best possible transfer of power from the transceiver to the load (antenna)?

If we do the math (not at this time, sorry), we find that a very high value of $\boldsymbol{Z_L}$ gives us the best efficiency; that is, the most amount of power going out the antenna for a given amount of power coming from the transceiver. But that "most amount of power" will be quite small, due to the large load impedance. On the other hand, a very low value of $\boldsymbol{Z_L}$ gives us the worst efficiency because most of the power will be dissipated in the transceiver instead of the antenna, possibly placing our transceiver finals in danger.

It turns out that the most amount of power we can get from our transceiver to our antenna, known as *maximum power transfer*, occurs when the source and load impedances match.

Notice I said "match" instead of "are equal" because "equal" only applies if the two impedances are purely resistive, which they rarely are. In fact, the word "match" means the two impedances are *complex conjugates* of each other, again an easy proof, but I'll spare you the unnecessary math. This means if the source impedance, as seen from the antenna end is **R + jX**, then the antenna must present an impedance of **R – jX** to allow for the maximum amount of power out of it from the transceiver. But we typically have the opposite problem, in that our antenna exhibits an impedance of **R + jX** ohms. How do we make our transceiver-and-feed line 50-ohm source match the antenna's **R + jX** load?

To perform the match between your transceiver and your antenna, you can create a matching network, such as a T network, pi network, or pi-L network, which all work very well, but they're only good for a small frequency range. Or you can use a *tuner*. The job of a tuner is to present a 50-ohm load to the transceiver and a **R – jX** load to your antenna. And it's adjustable, so its impedance matching isn't confined to a small range. Then again, you can use variable capacitors and variable inductors to perform the match in your home-made network, but today, a tuner is just plain convenient.

Impedance and SWR

The SWR (standing wave ratio) is the value of the maximum voltage standing wave amplitude compared with the value of the minimum amplitude. Standing waves arise due to *reflections* of a signal in a transmission line because of imperfect matching between the load (antenna) impedance and the lumped source impedance. Because SWR is calculated from the comparison of

Brass Tacks

continued

the incident (forward-traveling) signal and the reflected (reverse-traveling) signal, we start by a quantity known as the reflection coefficient (Γ):

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} \text{ and } SWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

It follows that

$$SWR = \frac{1 + \left|\frac{Z_L - Z_0}{Z_L + Z_0}\right|}{1 - \left|\frac{Z_L - Z_0}{Z_L + Z_0}\right|} = \frac{\frac{Z_L + Z_0 + Z_L - Z_0}{Z_L + Z_0}}{\frac{Z_L + Z_0 - Z_L + Z_0}{Z_L + Z_0}} = \frac{2Z_L}{2Z_0} = \frac{Z_L}{Z_0}$$

It turns out, therefore, that the SWR of an antenna can be calculated using impedances alone, and is simply ***the ratio of the antenna impedance to the feed line characteristic impedance***, or the ratio of the characteristic impedance to the antenna impedance, whichever is larger (to satisfy the absolute value condition).

A practical application

Many hams have discovered the value in long wire and EFHW (end-fed half-wave) antennas, because of their effectiveness and yet simple construction. The big problem with a long piece of wire, however, is that its natural impedance tends to be much higher than most amateurs are accustomed to. Even if you attempt to cut the wire to length according to formulas, their impedances typically range from 1800 ohms to 5000 ohms for HF frequencies.

It turns out that we can construct a transformer that converts the impedance of such a wire by matching its impedance on one side of the transformer and presenting a more usable impedance on the other. This technique of impedance matching is similar to what your tuner does, but to match this huge impedance difference is outside the ability of most tuners. The goal, then, is to design a transformer with a primary impedance of 50 ohms, and a secondary impedance of between 1800 ohms and 5000 ohms.

The transformer calculation will involve determining the number of required winding turns on each side, to match the impedances on both sides, since the voltages and currents are not only unknown, but unnecessary. We start by relating the numbers of turns **N** to impedances **Z**:

$$\frac{Z_S}{Z_P} = \frac{\frac{V_S}{I_S}}{\frac{V_P}{I_P}} = \frac{V_S \times I_P}{V_P \times I_S} \qquad V_S = V_P \times \frac{N_S}{N_P} \text{ and } I_P = I_S \times \frac{N_S}{N_P}$$

This is from the transformer relationship between turns ratios and voltages and currents. Continue substituting and canceling results in

Brass Tacks

continued

$$\frac{Z_S}{Z_P} = \frac{\left(V_P \times \frac{N_S}{N_P}\right) \times \left(I_S \times \frac{N_S}{N_P}\right)}{V_P \times I_S} = \frac{N_S^2}{N_P^2} = \left(\frac{N_S}{N_P}\right)^2$$

This means the impedances relate to each other by the square of the turns ratio. In the case of the long wire, the squares of the turns ratios are

$$\frac{5000 \text{ ohms}}{50 \text{ ohms}} = 100 \text{ and } \frac{1800 \text{ ohms}}{50 \text{ ohms}} = 36$$

For convenience, let's select a perfect square between those values, such as 64 or 49. Selecting 49, for example, will result in standing wave ratios of

$$\frac{1800 \text{ ohms}}{49} = 37 \text{ ohms, and } \frac{5000 \text{ ohms}}{49} = 102 \text{ ohms}$$

which in turn result in

$$\frac{50 \text{ ohms}}{37 \text{ ohms}} = 1.35 : 1 \text{ SWR, and } \frac{102 \text{ ohms}}{50 \text{ ohms}} = 2.04 : 1 \text{ SWR}$$

both well within most internal tuner (maximum 3.0:1 SWR) range. The required number of transformer windings are

$$\sqrt{\frac{Z_S}{Z_P}} = \sqrt{49 : 1} = 7 : 1$$

and then wind it with 14 turns on one side and 2 turns on the other (same 7:1 ratio) to improve mutual inductance while keeping ohmic losses (resistances) low.

Admittance

In a number of cases (as in the *characteristic impedance* example above), it's convenient to refer to the reciprocal of impedance, known as ***admittance***. This can be expressed as

Y = 1/Z

Just as the formula for impedance is

Z = R + jX, the formula for admittance is **Y = G + jB**

in which **Y** is the admittance, **G** is known as conductance, **B** is known as susceptance, and **j** is

Brass Tacks

continued

the same imaginary unit. Therefore, in terms of impedance, admittance is also

$$Y = 1/(R + jX)$$

and is the property of allowance (opposite of opposition) for electrical current flow, expressed in siemens, symbol S. At one time, it was proposed that the unit for admittance be the mho, which is backwards for ohm, but that idea never caught hold for long in either academic, professional, or SI circles, and was eventually dropped.

Polar form

From our discussion above, impedance is defined as the complex value

$$Z = R + j[2\pi fL - 1/(2\pi fC)]$$

which is its Cartesian ("rectangular") form. But, it can also be expressed in polar form, which is convenient for some calculations. Essentially, it is

$$Z = Z_{mag}\angle\varphi$$

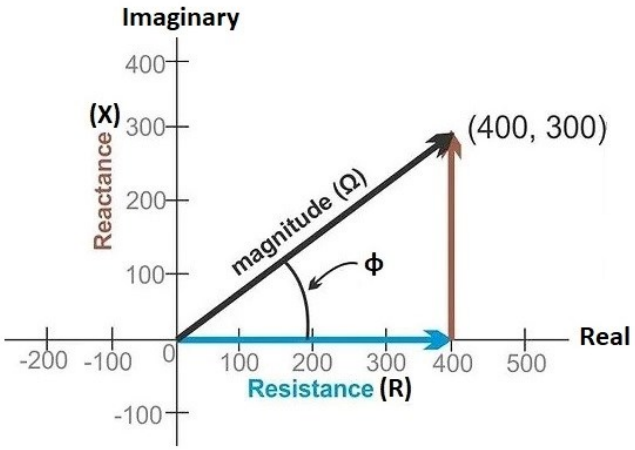
in which $Z_{mag} = \sqrt{(R^2 + X^2)}$ and $\varphi = \tan^{-1}(X/R)$, in which Z_{mag} is known as the *magnitude* and φ is the *phase angle*. To convert back to Cartesian format,

$$Z = Z_{mag}\cos\varphi + jZ_{mag}\sin\varphi$$

And converting between impedance and admittance is simply a matter of taking the reciprocal of Z_{mag} and reversing the sign of the angle. Therefore and impedance of $4\angle 30^\circ$ ohms equates to an admittance of $0.25\angle -30^\circ$ siemens.

The following graph represents a circuit impedance (400 + j300 ohms) in rectangular coordinates, for which the horizontal axis represents **R**, the resistance or the "real" component, and the vertical axis represents **X**, the reactance or "imaginary" component. This impedance is represented by using a positive **R** value (all resistances are positive values) and a positive **X** value.

But the graph also shows its polar equivalent if we draw a diagonal line from the origin to the end point of the **X** value, creating an angle φ between the **R** value and the diagonal line. Therefore, the impedance in this case is $Z = R + jX$, and is the same impedance is represented as $Z_{mag}\angle\varphi$. Just as **X** being positive tells you that the represented impedance is *inductively reactive*, the positive phase angle tells you the same. Had this reactance been negative, the angle would also have been negative, and the **X** segment would be drawn downward, below the horizontal axis, indi-



Brass Tacks

continued

cating that the impedance is *capacitively reactive*.

Finally

Let's get over a few pedantic semantics:

- Resistance is impedance. Reactance is impedance. The complex combination of resistance and reactance is impedance.
- Impedance is the opposition to current flow, whether that flow is in the form of alternating current, direct current, or some complicated mixture of signal types, such as digital, pulse, or a transient.
- The imaginary unit ***j*** is used here and in many texts instead of ***i*** to avoid confusion with the conventional ***i(t)***, which represents a time-varying current.

Also, we've omitted several relevant topics, such as complex power, AC circuit analysis, and parallel circuits, whose impedance calculations are important, but have limited this discussion in the interest of brevity. In fact, while writing this article, it became clear to me that impedance is such a large subject that I had to go back and remove some of the content, including some good examples. So, if you're wondering why I haven't mentioned your favorite impedance issue, it might just be my attempt at keeping this already-lengthy discussion to a sane length.

Summary

Electrical impedance is the opposition to current flow, and its value is represented by a complex number, combining resistance and reactance. Impedance affects the amount (volume) of electrons that's allowed to go through a component per second, and not their speed. It's the natural opposition to current flow of a conductor that's inherent to its material. Characteristic impedance is that due to the circuital makeup of a combination of conductors, such as coax. Non-unity SWR is due to the potential signal reflections from a load whose impedance does not match that of its transmission line, and so can be calculated from a ratio between the two. An impedance-matching network or device such as a transformer or a tuner can be inserted between the transmitter and the antenna to bring the antenna system to resonance and allow for maximum power transfer. Admittance is the reciprocal of impedance, simplifying some calculations. Both impedance and admittance can be expressed in polar, as well as Cartesian (rectangular), form.

Noji Ratzlaff, KNØJI (kn0ji@arrl.net)

Dear Annette

What's on your mind? Serious, humorous, technical, and thoughtful answers to your deepest, (mostly) ham-related questions.

Dear Annette:

I overheard a couple of people on the local repeater the other day talking about making a contact over EchoLink. Not sure how people think that making a contact over EchoLink is true ham radio. I thought that ham radio is communication between two radios over the radio waves. What are your thoughts?

Greg in Las Vegas

Dear Greg:

Think of your phone as nothing more than a microphone, and its internet connection to the target repeater a microphone cable. In that setup, you're simply accessing the target repeater as though it's your own radio, then communicating over radio waves with another operator who might be communicating by a handheld radio. Sounds a lot like ham radio to me.

Dear Annette:

Sorry for the newbie question, but I wonder if you could help me clear up some confusion. Yesterday, I saw a guy posting that the bands are completely dead on 10, 20, 40, and 80 meters, while at the same time another person said that 10, 20, and 40 were exploding with activity. They both seemed like knowledgeable hams, so how could the bands be both dead and active at the same time?

Jason in Provo

Dear Jason:

I remember calling my sister in Oklahoma one bright, sunny morning, only to have her tell me that she was in the middle of a torrential downpour. Just like with the weather, band conditions are a reflection of your personal observation at the moment, specific to your location. We tend to teach that the ionosphere is this perfectly uniform ball of coherent reflectivity, when in fact it more closely resembles a hollow shell made of Swiss cheese. Couple that with local differences between the two stations, such as antenna (type, quality, height), transmitting power, obstructions (mountains, indoors, mobile), time-of-day, operator skill, noise, and luck, and your experiences could end up being night and day.

Dear Annette:

With the ham radio exams the way they are, am I an idiot to believe that a ham can be expected to know anything about antennas and radio theory?

William in Cedar City

Dear William:

I don't believe you're an idiot, but I do believe that very few hams know much about amateur radio technology, and that's ok. Today, the overwhelming majority of people who get into amateur radio do so for preparation and utility, not for the hobby, so to them, understanding any of the technology is a nuisance, and that's ok too. That leaves it for the few of us who ***are*** a bit more tech-savvy to be their patient and available mentors. There are numerous facets to amateur radio, and we've only touched on two of them (preparation and technology). No need to expect ***others*** to know about antennas and transmitters, but I expect my own knowledge to be up-to-speed when they ask about them.

Got a question for Dear Annette*? Email it to* ***uvarcshack@gmail.com*** *and include your town name. Sorry, no guarantees.*

The Amateur in You, Part 1

What have you been pondering?

Social media in disaster communication

Facebook, Instagram, Twitter, Pinterest, Reddit, TikTok, and yes, even LinkedIn and YouTube are among a numerous collection of online sharing and collaboration platforms we term ***social media***. They allow people worldwide to engage in communal activity by posting comments, photographs, documents, videos, and much more.

Online tool

Because a huge volume of people use social media, it can be a lifeline for those who are in trouble, and are looking for help. It can also be an online collection point for vital information, meaning we can use it to coordinate a rescue, a family check-in, or for citizen location, health, and welfare accounting. Some use social media as their method of maintaining an out-of-state contact.

During a disaster, the internet might become locally unavailable, rendering social media somewhat useless. But two points to keep in mind are 1) ***the internet will likely remain available in most incidents*** and 2) ***the internet won't likely be down everywhere***. In all likelihood, you'll still be able to reach many people in spite of the emergency.

Through the use of social media, members of the public who witness incidents can provide public safety organizations with timely, geographic-based information. This can be used by decision-makers in planning response strategies, deploying resources in the field, and, in turn, providing updated and accurate information to the public.

From CivicPlus, ***If you fear that your emergency communication plan is lacking a crucial element, or have already lived through a disaster and know you fell short of reaching most residents, it's time to add social media to your communication mix.***

How to post

To maximize the effectiveness of your posts,

- Keep the messages short and actionable
- Be specific on affected areas, emergency actions, and radio information
- Post links to more detailed information, such as maps and shelter lists
- Include hashtags to amplify your reach
- If possible, update frequently

While the internet is available, post emergency radio frequencies you can use for your family, your church group, your work place, or your community. Indicate which repeater you recommend, along with the offset and tone, or whether your frequency is simplex. Indicate at what time you plan to be on the radio, if you're organizing a net or schedule. Then announce the emergency social media postings on your radio nets as traffic.

Finally

Social media has come under fire for several reasons, not the least of which is its rapid distribution of unverified information. People are free to post what they will on many social media sites, which can be good in the way of open expression, while destructive in the way it invites open bullying by those who sense little responsibility for consequence as a result of internet anonymity.

In spite of its shortcomings, we can still leverage social media as a significant platform for emergency contacting and incident information. Because social media is used by people of all ages, you're able to reach more of the interested or affected population than perhaps by any other way.

The Amateur in You, Part 2

What have you been pondering?

Electrical components overview

In separate articles, we've discussed in-depth how a variety of electrical components work and how to use them in circuitry, including some calculations. This discussion provides you with a brief summary of the electrical components mentioned on amateur radio exams, and their general functions, without going into detail. It's intended for those who want an overview of these mysterious parts without a requiring degree in Electronics. Yet each component title name is a link to an in-depth article, if you'd like to learn that detail.

We'll focus mainly on the basic components, so necessarily we'll omit some very good and important ones that might appear on exams, because the scopes of their functions extend beyond what we'll consider to be the fundamental items. These missing devices include general ICs (integrated circuits), ADCs (analog-to-digital converters), grounds, lightning arresters, power supplies (except batteries), linear amplifiers, solar panels, and more.

Battery

The terms being used interchangeably, a ***battery*** or storage ***cell*** is a device that uses chemical reactions to store *electrochemical potential energy*. Each battery presents a set amount of electrical pressure, measured in **volts**, symbol **V**. If the types of chemicals in a battery are such that the chemical reactions are reversible, we call that a *rechargeable battery*. The following chemical equation illustrates this operation, such that when chemicals **A** and **B** react, they produce chemicals **C** and **D**, and release electrical energy:

A + B ↔ C + D + electrical energy

Then, if you attach the battery to a charger and insert the electrical energy, the process reverses, so that **C** and **D** "unreact" and form chemicals A and B again; hence, the double-direction arrow. It's kind of like accidentally creasing a piece of paper, then reversing the process by heating up the paper and smoothing out the crease.

If they are non-reversible, then it's a *single-use battery*, and you must not attempt to recharge it. The following chemical equation illustrates the non-rechargeable, one-way operation:

E + F → G + H + electrical energy

Once the energy has been expended, the **G** + **H** reaction will not accept more energy to change back into **E** + **F**; hence, the single-direction arrow.

Battery capacity is listed in **Ah** (ampere-hours, or amp-hours), indicating that (ideally) the battery can produce a certain amount of current (number of amperes) for each hour of operation. It's like tearing a piece of paper: while reversing that tear is *not completely impossible*, the paper's just not worth the cost. Each battery's data sheet will list the battery's nominal (set, within a tolerance) *voltage*, *capacity*, and *amperage* details.

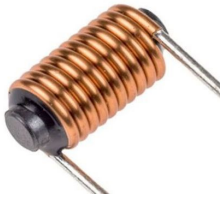
The Amateur in You, Part 2

Continued

Resistor

A resistor is a passive electrical component that opposes current flow of all kinds, and whose opposition to current flow is not affected by signal frequency. Each fixed resistor possesses a specific amount of resistance (within a tolerance range), measured in **ohms**, symbol **Ω**. Its purpose is to drop voltage across it by reducing the flow of electrons through it. A *variable resistor*, also known as a *potentiometer*, also possesses a specific amount of resistance, but additionally has an adjustable contact that allows it to present a variable resistance within its preset range of resistance.

Inductor



An inductor is a passive electrical component that opposes the flow of AC (alternating current), and whose opposition to current flow increases as the current's frequency increases. Unlike a resistor, whose flow opposition occurs because of resistance, an inductor opposes current flow by *inductive reactance*, defined as

$$X_L = 2\pi fL$$

in which **f** is the frequency and **L** is the inductance in Henries, symbol **H**. An inductor can be a simple coil of wire, and it stores energy temporarily in a *magnetic field* created by the coil. Because an inductor acts like a short circuit at low frequencies and an open circuit at high frequencies, we can say that, by itself, it functions like a low-pass filter, allowing the signals of lower frequencies to pass through it while attenuating (reducing) those of higher frequencies. An inductor and capacitor can work together to form a tuned circuit by using *resonance*.

Capacitor

A capacitor is a passive electrical component that opposes the flow of AC (alternating current), and whose opposition to current flow decreases as the current's frequency increases. Unlike a resistor, whose flow opposition occurs because of resistance, a capacitor opposes current flow by *capacitive reactance*, defined as

$$X_C = 1/(2\pi fC)$$

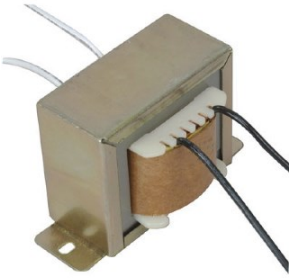
in which **f** is the frequency and **C** is the capacitance in Farads, symbol **F**. A capacitor can be a simple pair of metal plates or conductors close to each other, and it stores energy temporarily in an *electric field*. Because a capacitor acts like an open circuit at low frequencies and a short circuit at high frequencies, we can say that, by itself, it functions like a high-pass filter, allowing the signals of higher frequencies to pass through it while attenuating (reducing) those of lower frequencies. A capacitor and inductor can work together to form a tuned circuit by using *resonance*.

Transformer

A transformer is an inductor that transfers electrical energy from one circuit to another. In the amateur radio world, the basic functions of transformers are to transform voltages and trans-

The Amateur in You, Part 2

Continued



form impedances. They can made from a single wire (autotransformer), a pair of wires, or multiple wires, wrapped around a core made of iron, ferrite, or air. A transformer with a pair of wires can transform a lower voltage to a higher voltage (step-up transformer) or a higher voltage to a lower voltage (step-down transformer), because of the ratio between the number of wire turns on each side compared with that of the other.

We often refer to the two sides of a two-wire transformer as the primary side and the secondary side. Because the impedances of the two sides of such a transformer are directly proportional to the square of the turns ratio of the two sides, a transformer can be used to match impedances between circuits of different impedances, such as between a coaxial cable and an OFCD (off-center-fed dipole) antenna, to promote *maximum power transfer*.

Diode

A diode is an electrical component that allows current to flow through it in one direction. It's also called a *rectifier*; that is, it rectifies (makes positive) an AC (alternating current, or one that alternates directions) signal into a DC (direct current, or one that travels in one direction) signal. When the voltage across a diode is oriented such that current is allowed to flow through it, we say that the diode is *forward-biased*. The most common type of diode today is the silicon *semiconductor junction diode*, although there are many other useful ones, such as

Zener diode : provides a stable reference voltage in voltage regulator circuits, for example.

LED : a *light-emitting diode* emits visible or other kinds of light when it's forward-biased. It's a component that's quickly replacing energy-hungry incandescent bulbs around the world.

PV and photodiode : a photovoltaic cell (like you find in solar panels) and a photodiode are two examples of diodes that accept (not necessarily visible) light and transfer the *radiant energy* to the electrons, which result in current flow.

Germanium : material used for diode construction, which makes for a lower voltage drop and faster voltage change time, making it suitable for *demodulating* radio signals.

Others : include the Schottky, varactor / varicap, PIN, tunnel, and TVS, each of which provide valuable electronic functions.

Transistor

A transistor is a solid-state (not tube or gas-filled) device constructed from three or more *semiconductors* made of insulators that have had their chemistry altered to conduct electricity under certain conditions, and is arguably one of the greatest inventions of the 20th Century. The conditional conduction of the sandwiched semiconductors allow a transistor to amplify an input signal, such that the conduction is somewhat proportional to the input signal, making the output signal an enlarged (higher-power) replica of the input signal. A transistor can also work as an *electronically*

The Amateur in You, Part 2

Continued

controlled switch, to allow full conduction (called saturation) or no conduction, which forms the basic foundation for logic and computer circuitry.

Commonly used transistors include the BJT (bipolar-junction transistor), FET (field-effect transistor), and MOS (metal-oxide-semiconductor) types, but there are others. MOS is part of the FET family, and is better-called MOSFET because of the physical structure of a metal layer (typically Aluminum), an oxide layer (typically SiO_2), and a semiconductor layer (typically silicon) to perform transistor functions.

Vacuum tube

A vacuum tube is an electronic device that uses heated emissions of electrons passing between metallic objects to perform any of several functions, and enclosed in evacuated glass, metal, or ceramic. It was used as the first diode, because the electrons flowed only one direction, away from the heated cathode to the cooler anode. Depending on the type, a tube was once used as a *rectifier* (turns AC to DC), *amplifier*, *oscillator* (create sinusoidal waves), RF (radio frequency) *detector*, *mixer*, *demodulator*, and more. Plus, there are specialized vacuum tubes, such as the CRT (cathode-ray tube), magnetron, and X-rays.

Vacuum tubes were somewhat problematic, in that they required a lot of energy to perform their functions, and emitted a lot of heat as a result. Working with their high voltages could sometimes be a hazard. Because most had to maintain their vacuum in glass, the tubes were easily broken. And even when the glass remained intact, measures had to be manufactured in the tube to absorb any oxygen that leaked into the enclosure. As a result, their failure rate was relatively high, depending on the application.

Crystal oscillator

An *oscillator* is a device that produces a steady, periodic signal in the form of a sine wave or square wave. A crystal oscillator produces an oscillating signal by means of an physical piece of quartz or ceramic, which is very plentiful and can attain an oscillation of a very precise frequency. Typical crystal oscillators are able to generate oscillating frequencies to within a couple of parts per million, in spite of temperature changes, and provide the reference time base for computers and frequency synthesis in amateur radio. They're inexpensive, occupy little board space, possess automatic amplitude control, and require very little energy to maintain their oscillations.

Antenna

An antenna is a device that converts electrical signals into radio waves, collects radio waves, and converts received radio waves into electrical signals. In one form or another, nearly every antenna is a type of dipole, in that radio waves are emitted from one side of the dipole and received on the other side, then the two reverse operations a half-cycle later. The two sides are connected by *capacitance*, with air or space as the separating *dielectric*. An antenna that's

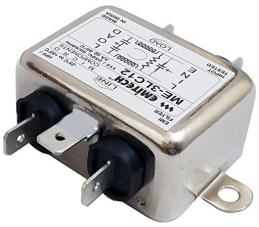
The Amateur in You, Part 2

Continued

built using only one of these two halves still requires the missing counterpart, or *counterpoise*, for proper operation. In this case, an antenna will often make use of other things that can bring the signal back to the radio, such as the chassis of an HT (handheld transceiver) or the shield of the coax (coaxial cable), if one's attached.

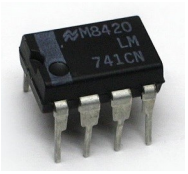
In the world of amateur radio, antennas have two basic arenas of function, *transmitting* and *receiving*. And because of *reciprocity*, each antenna's receive pattern is identical to its transmitting pattern, although experience doesn't always make that idea obvious. That *pattern* determines in what direction the antenna *gain* is pointed, and the directions of its relative signal *strengths* or *sensitivities*. And different antenna shapes, sizes (lengths), and especially its *height over ground*, affect that pattern.

Filter



A filter is a device that can be made from a single component, or more typically, a network of several things, usually resistors, inductors, and capacitors, arranged to perform their function together as a unit. Its purpose is to permit signals of specific frequencies to pass through it while rejecting signals of other frequencies. A filter can be very narrowly selective, passing only a small bandwidth of frequencies, such as with a *bandpass filter* or in a *tuning circuit*, or it can be made to pass signals of a very wide range of frequencies, such as with a *bandpass filter*. Some are designed to reject signals of specific types, such as in a *notch filter*.

Operational amplifier



An op amp (operational amplifier) is an IC (integrated circuit) made from a network of transistors and passive components to form a device that can not only be wired and configured to *amplify*, but to perform a number of other operations, such as that of an *oscillator*, a *filter*, and more. Because of its simplicity, low-cost, and versatility, the op amp can be found in most of today's electronics.

Switch

Is a switch an electrical component? Why not. The primary purpose of most electrical switches is to complete or break the path of electrical current. While a switch can be used to open or close a circuit at any spot, it's a vital part of most electrical pathways that provide electrical power to a device. The variety of switch types is huge, and include toggle, momentary, digital, relay, rotary, pushbutton, rocker, tactile, knife, dimmer, DIP, selector, capacitive, and combination, to name a few. Switches can be activated manually, automatically, electronically, or other by other means, such as makeshift (contrived, like simply plugging in the power cord). Some are "make-before-break" types.

Noji Ratzlaff, KNØJI (kn0ji@arrl.net)

Hot Tips

Good info for the new ham, and old stuff to refresh your memory

The prepared vehicle

Being prepared for an emergency at home is important, but how about when you need to evacuate, or when you're already on the road? Does your vehicle (car, truck, RV, boat, etc.) have everything you and your family need, to survive for a couple of days or more, in case of an incident that forces you to be portable?

Here are a few things take or consider, to be better prepared before you leave home:

Radio equipment

__ Mobile radio installed and programmed
__ External vehicle radio antenna installed
__ Vehicle broadcast radio works properly

Personal

__ Go-kit (backpack, personal and tool items)
__ First-aid kit (band-aids, gauze, antibiotic, anti-itch, Tylenol, anti-diarrheal, Pepto)
__ Bottled water
__ Basic food (MREs)
__ Hygiene needs (toilet paper, toothbrush, feminine, deodorant, comb, wipes)
__ Medication (prescription, OTC, vitamins)
__ Clothing (hoodie, gloves, coat, socks)
__ Blanket (regular and emergency)
__ Special or disability needs

Tools

__ Head lamp and flashlight
__ Knife
__ USB charger for cigarette lighter
__ Paper map of your area
__ Scissors, tweezers
__ Work gloves
__ Large candle (for warmth)
__ Multi-tool
__ Duct tape
__ Jumper battery (instead of jumper cables)
__ Pen and pad and permanent marker
__ Lighter and fire starter
__ Rope or paracord
__ Umbrella
__ Flares or safety light
__ Ice scraper / snow brush

Vehicle check

__ Tank is full of fuel
__ Proper fluid levels (transmission, coolant, oil, washer, steering)
__ Tires are in good shape
__ Tire pressure correct (tire gauge)
__ Lights work properly
__ Wiper blades are in good shape
__ Heater and A/C work properly
__ Check brakes, air filter, battery

Spare tire

__ You know where your spare is located
__ Your spare tire is in good shape
__ You know where your tire jack is located
__ You know how to change a flat tire

Practice

Stage an occasional drill with your family, using these items, to make sure you have the correct equipment and that you'll know how to use it when you really need to. There's nothing short of actually using something, to show you how little you know about how to use it.

Make sure you know how to use your mobile ham radio, your jumper battery, and your phone's GPS.

Finally

It's not feasible for you to carry all of this gear in your vehicle 24/7. But if you do need to leave in a hurry, you might want to have some of it ready ahead of time to easily grab on your way out.

DIY

Worthwhile projects you can build on your own

40/80 cobra linear-loaded dipole

Have you wanted to work 80 meters, but just don't have the space for a 133-foot wire, or aren't allowed to install a tall vertical antenna on your roof? This design will work 80 meters but is only 40 feet long, which can fit in an attic, between trees, or on your vinyl or wooden fence. The term "cobra" in the title comes from the fact that the 60-foot wire on each side is "linearly loaded," or snakes around to wrap down to 20 feet long.

The design for this antenna was adapted from one by Charlie Davy MØPZT, but made for coaxial cable instead of ladder line. The adaptation required the addition of a *1:1 current balun*, which is where we'll start.

Parts list

One toroidal FT240-31 ferrite core

120 feet 14 AWG stranded wire

Two 14 AWG #8 stud ring terminals

One 14 AWG #4 stud ring terminal

Two #8 screws, wing nuts, washers, split washers

One 4.7″ x 3.2″ x 2.6″ enclosure

Two dogbone insulators

One SO-239 bulkhead connector

72 inches of 22 AWG zip wire pair

One 1-½″ x 3/16″ eye bolt

4 each M3 screws, split washers, nuts

One 1-3/8″ x 2-7/8″ fiberglass screen

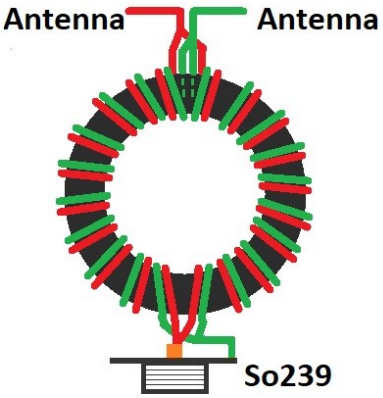
One ½″ 10-foot PVC pipe

Zip ties, hot glue and gun, Super Glue™

Construction

The diagram to the right shows what we're trying to accomplish. The purposes of this design are to a) maximize common-mode current reduction, b) minimize losses, while c) maintaining a 50-ohm impedance on both ends of the balun d) for a wide range of frequencies e) on 100 watts of transmit power.

Secure one end of the 22 AWG wire pair to the toroid with a small zip tie. Wrap the zip wire around one half of the toroid ten times, as shown:



DIY, continued

40/80 cobra linear-loaded dipole

Repeat this on the other half, but in an exact mirror image of the first. This way, the red wire is on the right with the first half, and on the left with the second half. It's not necessary to wind the wires perfectly straight on every turn; close enough will be good enough. The main thing you're striving for, is to wrap each wire such that it's about as tight on the toroid as you can get it, with no overlap by any of the wires.

For reference, let's call the ends of the wires at the top of these photos the ***antenna end***, and the other end the ***transceiver end***.

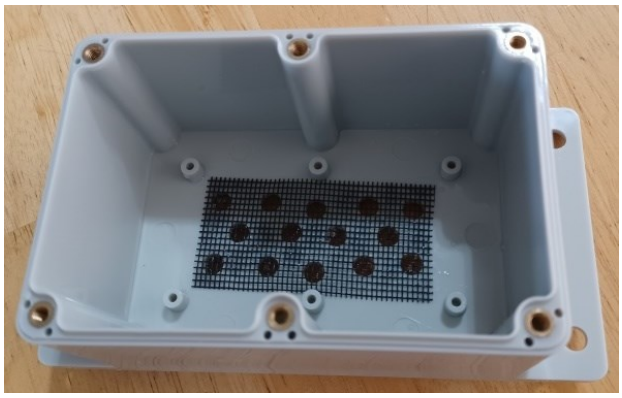
Strip all eight wires. Solder the two red wires of the antenna end to a #8 ring terminal, and solder the two black wires of the same end to another #8 ring terminal. Solder the two black wires of the transceiver end to a #4 ring terminal and solder the two red wires of the same end twisted together. Set the coil aside for now.

DIY, continued

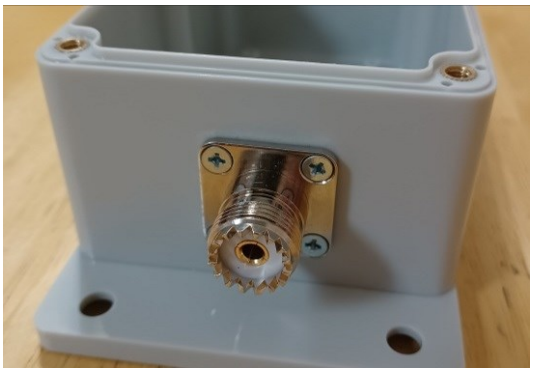
40/80 cobra linear-loaded dipole

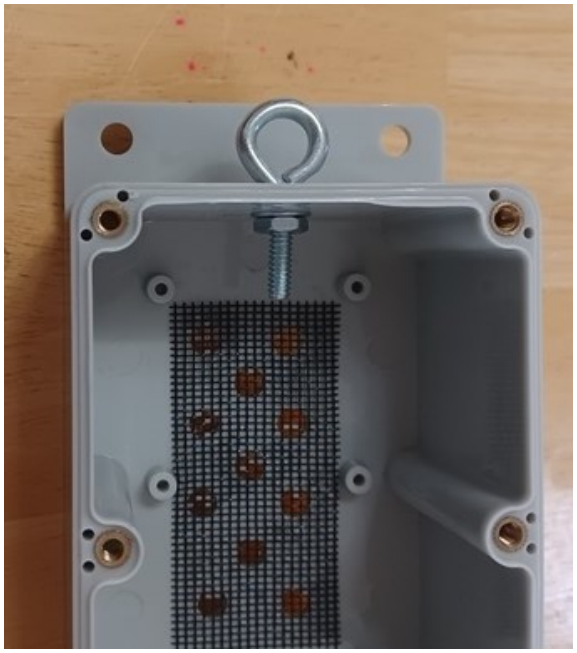
Enclosure assembly

Drill eleven to fourteen ¼″ holes in the back of the enclosure, for ventilation. Cover the holes by super-gluing the fiberglass screen over them on the inside, to prevent insects and debris from entering the enclosure.



Drill a ½″ hole in the enclosure at one end I'll call the ***balun bottom***. Place the solder cup end of the SO239 bulkhead into the ½″ hole on the outside of the enclosure, and using the four mounting holes of the bulkhead as a template, drill a 1/8″ hole for each mounting hole. Assemble the bulkhead onto the enclosure using the M3-0.5 mm hardware.





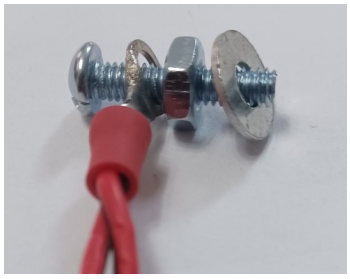
Drill a 3/16″ hole in the ***balun top***, about 1-¼″ from the back of the enclosure. Install a flat washer onto a 3/16″ eyebolt, and slip the eyebolt assembly through the hole. Secure the eyebolt with a split washer and another nut. This eyebolt can be used to hang the balun and relieve some of the strain on the wire elements due to the weight of the balun and the coax.

Drill two 3/16″ holes on opposite sides of the enclosure about an inch below the balun top (the end opposite that of the bulkhead connector). For each side, install a #8 machine screw through one of the #8 ring terminals of the coil antenna end, screw on a nut, then a flat washer, then insert the screw assembly through the 3/16″ hole from the

DIY, continued

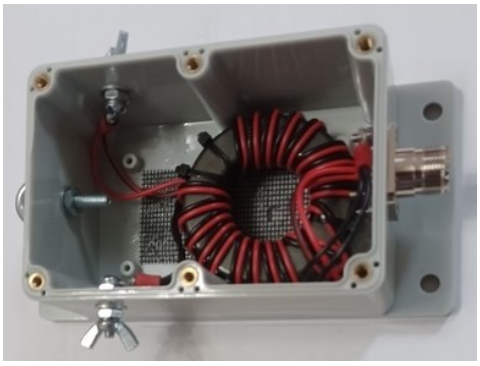
40/80 cobra linear-loaded dipole

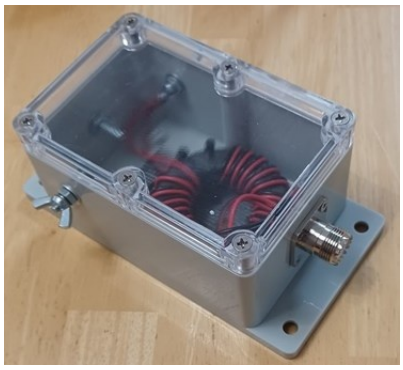
inside. Install another flat washer, nut, and wing nut onto the same machine screw on the outside of the enclosure.



Severed PL-259 connector used as a heat sink

Plug a PL-259 connector into the SO239 bulkhead, for a heat sink. If you don't plug in a connector, soldering the cup in the rear of the bulkhead can get hot enough to melt the dielectric, especially if you're using a low-wattage (under 60 watts) soldering iron. At the transceiver end of the wired toroid, lay the coil comfortably into the enclosure and solder the two red wires to the center soldering cup of the bulkhead. Bolt the #4 ring terminal of the two black wires to one of the M3-0.5 screws of the bulkhead.

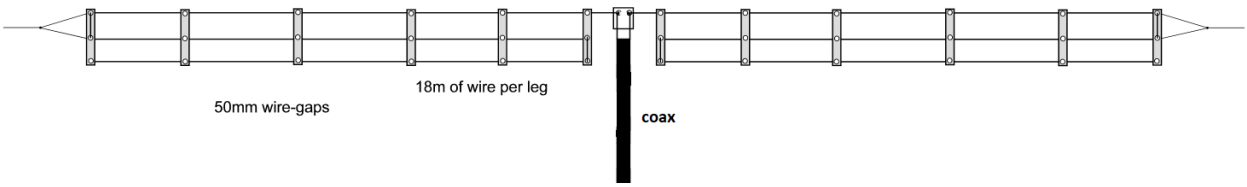




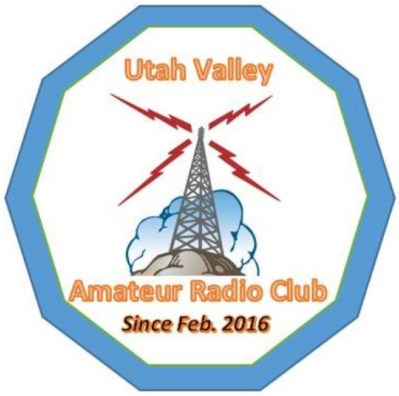
Secure the coil to the inside of the enclosure, if you feel it's necessary. Install the enclosure cover, and the balun construction is complete.

Element assembly

The following illustration depicts our goal. The idea is to thread 60 feet of wire ***on each side*** through short PVC tube sections, to maintain their shapes and distances.

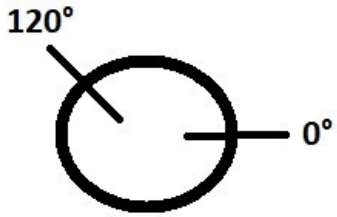


Clean the ½″ PVC pipe and cut twelve 5″ sections. In each section, drill two 3/16″ holes in the

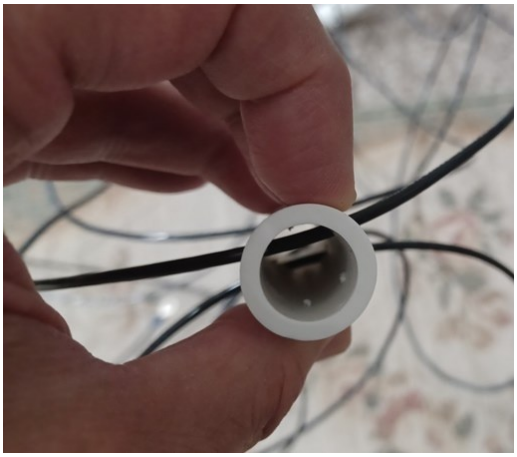


DIY, continued

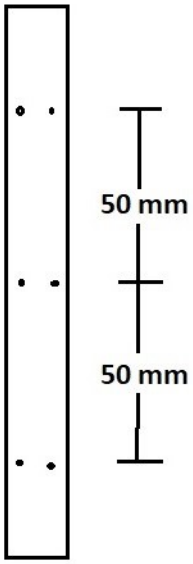
40/80 cobra linear-loaded dipole



PVC spreader with two holes for stability



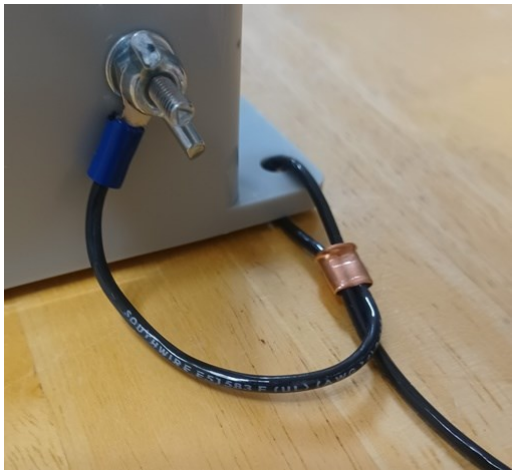
middle of the tube, at 0˚ and 120˚ angles, looking down into the tube. Repeat this for two more holes 50 mm from the middle holes toward one end, and two more holes 50 mm toward the other end.



Cut two 60-foot lengths of the 14 AWG stranded wire, and thread the wire through each set of two holes, as shown by the lines in the figure to the left, and the photos below it.

Slip the balun end of each antenna element wire through a crimp sleeve, through the enclosure external mounting hole, then back through the crimp sleeve. Solder a #8 ring terminal to that end, and secure the ring terminal to the #8 machine screw by the wing nut on the side of the balun. Ensure the crimp sleeve allows for enough wire room to keep the strain off the ring terminal, then crimp the sleeve. Repeat all this on the other side. Then, slip the antenna wire end opposite the balun end through a dogbone insulator and tie it off.

Testing the antenna



To test the 80-meter cobra antenna, mount it flat-top (horizontally), with the coax hanging straight down from the balun. It's best to keep the antenna at least 40 feet off the ground during use, but during testing you might be able to get away with raising it only 16 feet up, which will affect the feed point impedance, but might be good enough for our demonstration.

I had to keep the bottom row of the elements stretched tight by some paracord all the way across, to prevent the wires from bunching and coiling. Once I mounted the antenna between a couple of masts, I connected my Icom IC-718 and got on the air. I could hear many stations, and ended up making a contact with W6WWW in Ft. Myers, Florida. I gave him a 33 report, but he only gave me a 31. Since he was on a pair of HamSticks, that's not surprising. At any rate, it looks like it works. Just for grins, I tried it on

DIY, continued

40/80 cobra linear-loaded dipole

20 meters, and it happened to tune up nicely there.

You can place this balun outside, even in the rain. Be sure to wrap your coax connector with silicone seal, to keep moisture from entering your coax at that junction. To make it completely waterproof, you should cover the SO-239 bulkhead inside the enclosure with hot glue or similar. The following shows the finished antenna, mounted flat-top 18 feet up:

This antenna was not an easy build; in fact, it was kind of a pain in the neck, and required a lot of time a patience. The balun was not difficult, but took time. Pulling the wire through the spreaders just right took way longer than it should have. In the end, the cobra linear loaded dipole antenna was worth the trouble, for a shortened version of an otherwise large antenna.

Summary

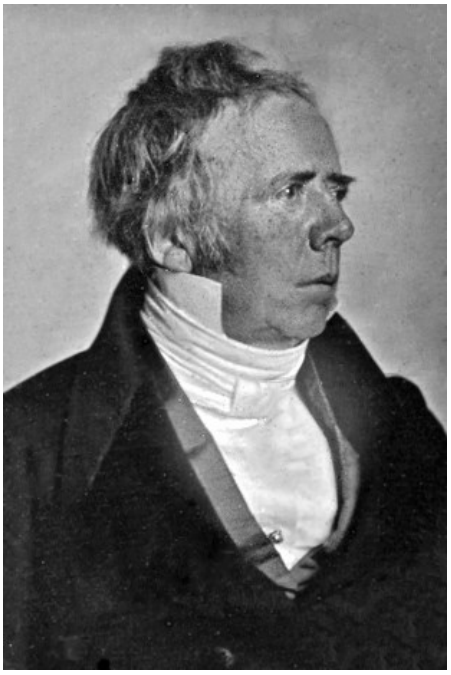
The cobra antenna is a limited-space version of a dipole antenna, with its element wires folded back onto itself in an RF-constructive fashion. The major effort for its construction is the 1:1 current balun, to reduce the common-mode current that would otherwise likely be picked up by the coax and brought into the shack. However, the PVC sections make this antenna rather bulky, and I'm sure I could have selected something less awkward to make the spreaders, but the pipe was inexpensive and easy to drill.

Noji Ratzlaff, KNØJI (kn0ji@arrl.net)

Living in the Past

Historical perspective

Professor of electromagnetism



In April 1820, while setting up an experiment on his table preparing for his lecture, professor Hans Christian Oersted demonstrated (not by accident, as some insist) that electric current through a wire causes a needle in a nearby compass to deflect. The significance of this discovery was recognized almost immediately, and others in the scientific community began reproducing Oersted's experiment and publishing subsequent findings.

Today, many of us recognize the simple experiment with a battery, wires, and a compass from elementary school. Back in 1820 the idea was quite game-changing, and led to the development of the transformer, the electric motor, and Tesla's coil. These devices ushered in the Second Industrial Revolution, which automated a huge amount of manual factory and farm labor and improved the global economy.

Hans was quite the prodigy. At age 12, he began helping his pharmacist father, sparking an early interest in chemistry. At age 16, Hans passed the University of Copenhagen's entrance exam. By age 19, he graduated with a degree in pharmacology, and at age 22 earned his PhD. By age 29, Hans was named a professor of physics at the University of Copenhagen.

The result of Oersted's experiment came to be known as Oersted's Law, which essentially states that ***an electric current creates a magnetic field***, and leads to five basic conclusions:

- *The magnetic field lines encircle the current-carrying wire (in the direction dictated by the right-hand rule)*
- *The magnetic field lines lie in a plane perpendicular to the wire*
- *The magnetic field direction reverses if the current direction is reversed*
- *The strength of the field is directly proportional to the magnitude of the current*
- *The strength of the field at any point is inversely proportional to the distance of the point from the wire*

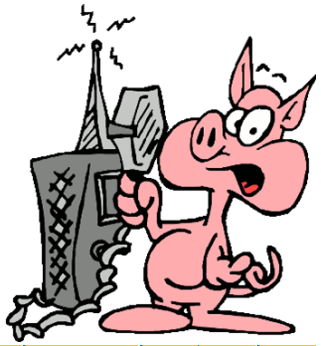
The idea that Oersted was the first to demonstrate a magnetic field created by an electric current was challenged, due to an experiment by Gian Romagnosi in 1802. Today, however, we know that Romagnosi's experiment did not involve a flowing electrical current, but observed motion in a magnetic needle, likely due to built-up static charge.

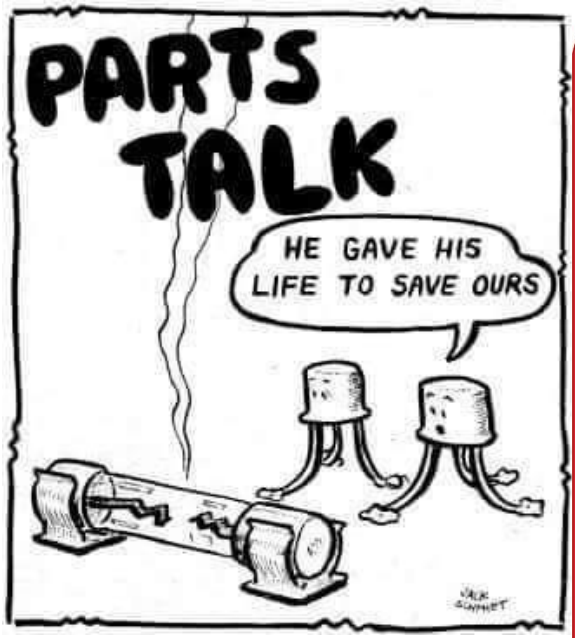
Hans had always been fascinated by science in general, but chemistry in particular. He was the first to isolate aluminum as an element, he isolated the sharp-tasting chemical in peppers, and was the first to coin the term *Thought Experiment*, a scientific proof process often attributed to Albert Einstein.

The CGS unit for ***magnetic field strength*** (the **oersted**, symbol "Oe") was named in honor of Hans's ground-breaking work.

Side of Bacon

A little ham humor





For Your Insight

Information you could use

Club meeting format

Here's the usual agenda for club meetings, at the Orem City Council Chamber Room, 56 N State St:

Talk-in frequency on the club repeaters

6:30 pm : Eyeball QSO

socialize / put faces with call signs

radio programmers available to help you

6:45 pm : Call the meeting to order

meeting lineup (agenda)

announcements / calendar / new hams

7:00 pm : Discussion / presentation

7:45 pm : Door prizes

7:55 pm : Dismiss and disassemble

8:00 pm : *Club QSY* to a local eatery

Something you'd like to see at the meetings?

Thanks to Heath Stevenson for making our monthly meetings possible!

Monthly meeting help

We're grateful for the volunteers who help with various tasks that make our club night just that much more friendly and useful to everybody. Monthly, we need help with

programming radios (thanks, Loren / Ralph!)

taking photos or videos during the meeting (thanks, Joe!)

operating the talk-in radio

setting up tables and chairs (thanks, Heath!)

Lynx

Websites for your education and leisure

Ham Radio Equipment
Ham Radio Nets
Radio Programming
Net Training Topics
76ers Group and UVARC Group pages
New Ham Page

Send your input to ***uvarcshack@gmail.com***

Test your knowledge

General and Extra review (answers next page)

G9DØ4 : What is the primary purpose of antenna traps?

A. To permit multiband operation
B. To notch spurious frequencies
C. To provide balanced feed-point impedance
D. To prevent out-of-band operation

E7G12 : What is an operational amplifier?

A. A high-gain, direct-coupled differential amplifier with very high input impedance and very low output impedance
B. A digital audio amplifier whose characteristics are determined by components external to the amplifier
C. An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
D. A RF amplifier used in the UHF and microwave regions

Calendar

What's happening
(times are Mountain Time)

Provo Ham Exam Sessions

Provo Fire Station #2, 2737 N Canyon Rd

Sign up at HamStudy.org/sessions

Wed 16 Aug, 7:00 to 8:30 pm

Sat 16 Sep, 2:30 to 5:00 pm

Wed 20 Sep, 7:00 to 8:30 pm

Wed 18 Oct, 7:00 to 8:30 pm

Sat 21 Oct, 2:30 to 5:00 pm

*Email **uvhamtest@gmail.com** for info*

Provo One-day Technician Courses*

Third Saturday Monthly at 8:00 am

Provo Fire Station #2, 2737 N Canyon Rd

** September through April*

2023 Orem Ham Radio Courses

Sign up at psclass.orem.org

Technician : Sep 19, 26, Oct 3, 10

Club Meeting Calendar (6:30 pm)

On YouTube Live, and Facebook Live

August 3	September 7
October 5	November 2 *
December 7*	January 4
February 1	March 7

† *Ham Radio Fair, Pheasant Brook Park*

* *At the Orem Friendship Center*

Regular Nets

UVARC Family Net, Sun 3:30 pm, 146.780

NE UC ERC Net, Sun 9:00 pm, 147.540 (s)

UVARC Ladies' Net, Tue 7 pm, 146.780

DMR Utah Net, Wed 6 pm, TG 3149, CC 1

Utah 76'ers, Wed 7 pm, 146.760

UVARC HF Net, Wed 9 pm, 28.345 / 7.220

UVARC New Ham Net, Thu 7 pm, 146.780

CERT Ham Net, 2nd, 4th Thu 8:pm, 146.780

Utah County 6-meter Net, Fri 8 pm, 50.140

Family History Net, Sat 8 pm, 146.780

See a larger list of nets at noji.com/nets

Upcoming Contests

European HF Championship

6 am to 6 pm Sat Aug 5

North American QSO Party (NAQP), SSB

Noon to midnight Sat Aug 19

State QSO Parties

Sat Aug 26 : HI, KS, OH, Islands

State QSO Parties

Sat Sep 16 : TX, NJ, NH, WI, WA

See a larger list at contestcalendar.com

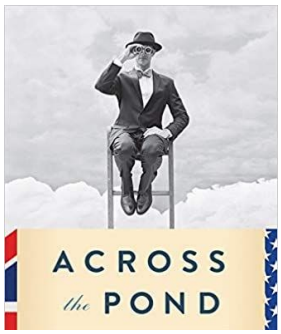
Answers to *Test your knowledge*

G9DØ4 : **A** (To permit multiband operation)

E7G12 : **A** (A high-gain, direct-coupled differential amplifier with very high input impedance and very low output impedance)

Across the Pond

That is, the Utah Lake 'pond'



Eagle Mountain ham radio activities

This is a list of amateur radio activities that are organized near Eagle Mountain, primarily by Dave Becar KI6OSS. Unless otherwise noted, all these activities will be held at the Eagle Mountain City Hall, 1650 Stagecoach Run. Please contact Dave at **ki6oss6365@gmail.com** to register for any of the classes or exams, for any additional information, or questions in general.

August 2023 Technician Course

Thu 03 August, 7 to 9 pm
Wed 09 August, 7 to 9 pm
Thu 17 August, 7 to 9 pm
Thu 24 August, 7 to 9 pm
Thu 31 August, 7 to 9 pm

Ham Radio Exam Session

Sat 02 September, 10 am
Open to all, for any license class

Hands-on class

Thu 07 September, 7 to 8 pm

October 2023 Technician Course

Thu 05 October, 7 to 9 pm
Wed 11 October, 7 to 9 pm
Thu 19 October, 7 to 9 pm
Thu 26 October, 7 to 9 pm
Thu 02 November, 7 to 9 pm

Ham Radio Exam Session

Sat 04 November, 10 am
Open to all, for any license class

Ham Radio Nets

Eagle Mountain ECT Net
Sundays, 9 pm 145.230- MHz (131.8 Hz)

Eagle Mountain Chimney Rock Stake
Sundays 8:30 pm 446.500 (s)

Eagle Mountain Central Stake
Saturday 8 pm 145.650 (s)

Vendors

For your convenience

Pockrus Joystick J-pole

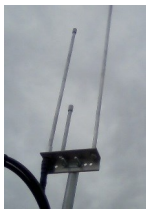
$30, open-stub aluminum half-wave, dual-band J-pole antenna

$40, 6-meter dipole, $20 for the 220 MHz (1.25 m) antenna

by Carl Pockrus, WE7OMG (email omgantennas@gmail.com to order)

Half-wave performance, solid construction, weather-proof, low wind-load

Probably the best-performing outdoor antenna you can get for the price



Super-Elastic Signal Stick

$20, vertical quarter-wave flexible antenna

by Richard Bateman, KD7BBC, of *SignalStuff* (and maker of *HamStudy*)

Super-performing antenna for your HT (handhold transceiver)

Visit SignalStuff and select SMA-Male, SMA-Female, or BNC

Ham Radio Podcasts v1.50

by Trevor Holyoak, AG7GX (email android@holyoak.com)

Stream podcasts (such as *100 Watts and a Wire*, *Amateur Radio Newsline*, *ARRL Audio News*, etc.) or download for later listening

For Android 4.1 and up (ad-free available for purchase)

Club Logo and Call Sign Embroidering

Want your call sign or name (or both!) embroidered on your shirt, your hoodie, your duffle? Or how about a club patch with your call sign?

by Glenna Gardner, WE7SEW (glenna0354@gmail.com or text 801-592-2503)

Call sign or name = $5, Both = $8, UVARC patch = $5, Patch with call = $9

Portable Aluminum J-pole

$60, sectioned, open-stub aluminum half-wave, dual-band J-pole antenna

by Stan, KJ7BDV and Kent, N7EKF (email skantenna@yahoo.com for info or call 801-372-7260)

Complete antenna breaks down into a compact 2″ x 6″ x 12″ package weighing only 3 lbs, perfect for backpacking and portable work where you really need a good 2-meter antenna

HamBadgers

Amateur radio name badges and other products

$10, official UVARC ham radio name badge with the club logo

Visit Ham Badgers and select Ham Radio Clubs > Utah Valley Amateur Radio Club

Email Eric Palmatier at hambadgers@gmail.com or call 919-249-8704

Where everybody knows your call sign

Utah Valley Amateur Radio Club
PO Box 1288

K7UVA
Phone/Text: 801-38-1865
Email: k7uva@arrl.net

Repeaters: 146.780–, 100.0
448.200–, 100.0 224.560–, 100.0
145.250-, 100.0 448.225-, 100.0
Newsletter input?
Email uvarcshack@gmail.com
Need help?
Email uvarcelmer@gmail.com

[See all our newsletters on uvarc.club]

We are the *Utah Valley Amateur Radio Club*, a 501(c)(3) non-profit (EIN 81-360-6416) Utah corporation that was organized in an obscure Orem fire station on 02-05-2016 to provide amateur radio enthusiasts in Utah County and surrounding areas a way to gather and discuss all things ham. Our primary purposes are to provide a local amateur radio resource, help new hams in their new-found adventures, and to give more experienced hams a reason to share their wealth of knowledge and wisdom in a friendly atmosphere of fellowship. We're an ARRL Affiliate and work in cooperation with the Utah VHF Society, but are not subsidiary to them, to ARRL, ARES, or any other organization, although many of our members and leaders might also belong to the same.

This newsletter is copyrighted and published by the Utah Valley Amateur Radio Club, and its purpose is to convey the tone and temperament of the club, to inform and entertain its members, and to entice the rest. To join, go to uvarc.club/join, then sign up at www.facebook.com/groups/uvarc/ to stay informed. For more information about our club or about amateur (ham) radio in general, please email or text or call us.

More than just a club, we invite you to become part of a great ham radio movement in Utah Valley

Our fearless leadership

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From all of us to you, 73